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(54) Epitrochoidal pump

(57) The invention falls within the sector of volumetric pumps and relates to an epitrochoidal pump, comprising:

- at least one rotor (6) which performs a roto- translatory movement inside a chamber (5) with a trochoidal profile and is driven by an epitrochoidal gearing (7, 8);
- separator elements (16) applied to the rotor (6) and to the walls of the chamber (5) so as to define inside said chamber (5) at least three areas which are separate from one another and the positioning and volume of which vary cyclically owing to the movement of the rotor (6);
- two inlets for suction ducts (10, 11) and two outlets for delivery ducts (13, 14) arranged inside the chamber (5) so that, whatever the position of the rotor (6), both a suction duct and a delivery duct are always active.

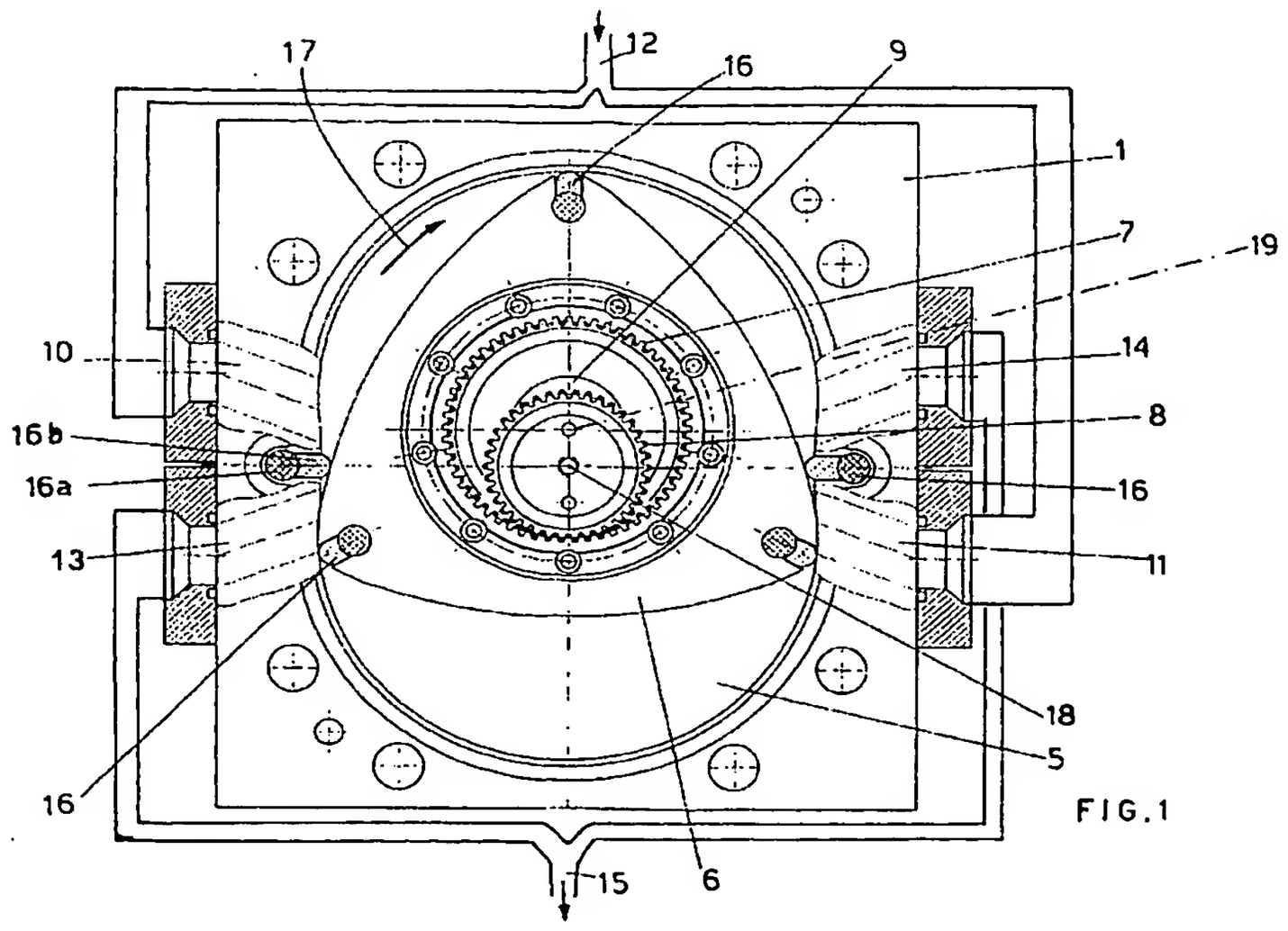

FIG.1

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Description

The present invention relates to an epitrochoidal pump.

It is known of gear pumps consisting of a casing having formed inside it two cylindrical chambers communicating with one other and housing two toothed wheels or gears meshing with one another.

One toothed wheel is keyed onto a driving shaft which emerges from the casing of the pump so as to be motor-driven, while the other one is keyed onto a driven shaft again supported by the casing.

One of the cylindrical chambers is connected to the duct for suction of oil from a tank, while the other chamber communicates with a pressure delivery duct The two toothed wheels form the gearing which traps the oil and forces it into the delivery duct in accordance with a principle already known. Said pumps, however, are somewhat noisy, have pause times and do not allow perfect continuity of flow.

EP 0,692,633 discloses a gear pump having formed inside it two parallel cylindrical seats communicating along a common generatrix and having inserted in them two toothed wheels meshing with one another and mounted on rotational shafts supported by bushes in seats formed in the pump body. Said pump comprises means housed in the pump body and designed to exert on each shaft of each toothed wheel a thrusting force with a direction and intensity such that, when combined with the resultant of the forces due to the pressure and meshing, it eliminates the play between the teeth of the toothed wheels.

The aforementioned solution, although less noisy, also does not solve the problems of the known art.

It is known of volumetric rotating internal-combustion engines, such as the Wankel engine, provided with a rotor having a trilobate shape and performing a roto-translatory movement inside a cylindrical chamber with a trochoidal profile formed in the stator.

The rotor divides this chamber into three separate spaces, the volume of which, owing to the movement of the rotor, varies cyclically from a maximum to a minimum

The stator has formed in it on one side the inlet and discharge openings which are opened and dosed by the rotor in a manner similar to that of a two-stroke engine and, on the other side, the sparking plug.

This engine, although having an optimum volumetric efficiency, is penalized by the operating conditions of the sparking plug (compared to alternating engines) on account of the sparking frequency and temperature. It also has a fairly low mechanical efficiency, has difficulty in disposing of the heat absorbed by the rotor and has drawbacks as regards the resistance of the frontal and peripheral seals to the hot gases and to wear due to the sliding friction.

The object of the present invention is to eliminate the aforementioned drawbacks and provide a volumetric pump, particularly suited for dense products, which allows a continuous flow to be obtained and which is self-priming.

A further object is to provide a pump which has small dimensions, but a high throughput with a low number of revolutions, and which does not subject the treated fluid to stressing effects.

Said objects are fully achieved by the epitrochoidal pump according to the present invention, which is characterized by the contents of the claims indicated below and in particular by the fact that it comprises at least one rotor which performs a roto-translatory movement inside a chamber with a trochoidal profile and is driven by a epitrochoidal (or epicyclic) gearing; separator elements applied to the rotor and to the walls of the chamber in order to define inside said chamber at least three areas which are separate from one another and the positioning and volume of which vary cyclically owing to the movement of the rotor; two inlets for suction ducts and two outlets for delivery ducts arranged in the chamber so that, whatever position the rotor, a suction duct and a delivery duct are always active.

Basically the inventive idea of the present invention is that of having devised a volumetric pump by means of transformation of the Wankel engine.

In particular, the optimum volumetric efficiency of the Wankel engine is exploited, while at the same time the defects of this engine (operating conditions of the sparking plug, difficulty in disposing of the heat) are eliminated, since in the pump there is no combustion phase, but only suction and delivery.

This has been made possible by inserting two suction inlets and two delivery outlets which are activated in a staggered and cyclical manner by the rotor so as to create that continuity of flow which is absent in conventional pumps. In fact in the present pump there is always an active suction duct and an active delivery duct and there are no dead centres where suction and/or delivery are closed.

Moreover, the sealing members have been improved.

These and other characteristic features will emerge more clearly from the following description of a preferred embodiment illustrated purely by way of a non-limiting example in the accompanying drawings, in which:

- Figure 1 shows a partially sectioned front view of the pump;
- Figure 2 shows a middle section through the drive shaft.

With reference to the Figures, 1 denotes the body of a pump, consisting of a casing 2 which is enclosed by two flanges 3 and 4 and defines inside it a cylindrical chamber 5 with a trochoidal profile inside which a rotor 6 rotates. The rotor 6, which has a substantially triangular trilobate shape, has inside it a toothing 7 with which a toothed wheel 8 fixed to the flange 3 meshes. The toothed wheel 8 is therefore stationary and does not ro-

tate, while the rotor 6 (which has the toothing 7) is made to rotate by means of a drive shaft 9 of the pump which terminates in a rotational axis 19 (kinematically connected to the rotor 6) which is eccentric with respect to the main axis 18 of the drive shaft 9 and the toothed wheel 8.

The toothing 7 and the toothed wheel 8 form an epicyclic gearing in which the toothing 7 rotates integrally with the rotor 6 about the stationary toothed wheel 8.

10 and 11 denote two suction ducts which lead into the chamber 5 and merge, outside the pump, into a common suction pipe 12.

13 and 14 denote two delivery ducts which lead into the chamber 5 and merge, outside the pump, into a common delivery pipe 15.

Separator elements 16 are provided at the vertices (or rather at the corners) of the rotor 6 so as to ensure that the rotor itself, during its epitrochoidal rototranslatory movement, divides up the chamber 5 into three separate areas, the positioning and the volume of which vary cylically and continuously owing to the movement of the rotor.

Additional separator elements 16 are provided, with same function, inside the chamber 5 in a middle position and facing each other. Each separator element consists of a body 16a made of elastically deformable material and a flange or strip 16 made of wear- and friction-resistant material and suitable for alimentary purposes. In the case in question, teflon strips have been used.

The remaining parts of the pump have not been described in detail, nor indicated with reference numbers, since they are substantially known or in any case sufficiently clear in the drawings to be understood by a person skilled in the art.

According to a variation of embodiment, not illustrated, it is possible to envisage the use of several trilobate rotors.

As regards operation, when the product is sucked in by the suction duct 10, the delivery occurs through the duct 14 (as in the case illustrated in the figures), while the ducts 11 and 13 remain inactive owing to the facing separator elements 16 provided in the middle zone of the chamber 5.

Rotation of the rotor in the direction indicated by the arrow 17 subsequently produces activation of the suction duct 11 and the delivery duct 13, while the ducts 10 and 14 became inactive.

At any time, activation of a suction duct and a delivery duct is ensured, so that the flow inside the pipes 12 and 15 is of the continuous type.

For each rotation of the rotor, therefore, six areas are used (the three areas into which the rotor divides the chamber, doubled in each case owing to the presence of the double suction and double delivery).

A comparison of the present pump with gear pumps or lobe pumps reveals the advantage of being able to have a kind of continuous piston (the trilobate rotor) which allows a flow of the continuous type both during suction and during delivery, while conventional pumps are subject to pulsation (owing to the dead time or pauses caused by the gearing or the lobes) and there is a reduced suction capacity.

The present pump is moreover of the dry self-priming type, which does not need to be filled with fluid and which therefore does not require a complementary system for priming.

This is a direct consequence of the sealing members, or the separator elements, which are formed with a resilient body and a teflon flange and which follow the movements of the rotor inside the chamber, causing the flanges to adhere to the walls of the chamber itself.

The present pump allows high throughputs with a low number of rotations and small dimensions.

In the embodiment illustrated, in which for every three rotations of the drive shaft a complete rotation of the rotor occurs, a throughput of about 20,000 litres/hour has been achieved with a rotor of about 70 mm which rotates at a velocity of about 100 revolutions per minute.

A further advantage of the present pump is provided by the reversibility, since it is sufficient to change the direction of rotation of the rotor in order to interchange the delivery and suction.

Another advantage of the present pump consists in the fact that it has a single pumping element (the rotor) which exerts a gentle action on the fluid or on the treated product, this being particularly useful when using the pump for dense alimentary products which must not be damaged mechanically.

Claims

1. Volumetric epitrochoidal pump, in particular for dense alimentary products, characterized in that it comprises:

   - at least one rotor (6) which performs a rototranslatory movement inside a chamber (5) with a trochoidal profile and is driven by an epitrochoidal gearing (7, 8);
   - separator elements (16) applied to the rotor (6) and to the walls of the chamber (5) so as to define inside said chamber (5) at least three areas which are separate from one another and the positioning and volume of which vary cyclically owing to the movement of the rotor (6);
   - two inlets for suction ducts (10, 11) and two outlets for delivery ducts (13, 14) arranged inside the chamber (5) so that, whatever the position of the rotor (6), both a suction duct and a delivery duct are always active.

2. Pump according to Claim 1, wherein each separation element (16) consists of a body (16a) of resiliently deformable material inside which a flange (16b) of wear-resistant material is inserted.

3. Pump according to Claim 2, wherein said flange (16b) is made of teflon.

4. Pump according to Claim 1, wherein the two inlets are connected to two suction ducts (10, 11) which merge into a single common suction pipe (12), while the two outlets are connected to two delivery ducts (13, 14) merging into a single common delivery pipe (15).

5. Pump according to Claim 1, wherein the rotor (6) has a substantially trilobate triangular profile.

6. Pump according to Claim 1, wherein there are provided two facing separator elements (16) applied to the internal wall of the chamber (5) in the middle zone in order to separate said areas from one another.

7. Pump according to Claim 1, wherein the rotor (6) is provided with separator elements (16) at each vertex or corner of its triangular shape.

8. Pump according to Claim 1, wherein the rotor (6) has inside it a toothing (7) which meshes with a stationary toothed wheel (8) fixed to a flange (3) of the pump body.

9. Pump according to Claim 8, wherein the rotor (6) is driven by a drive shaft (9) having a main axis (18) coinciding with that of the toothed wheel (8) and terminating in an axis (19) kinematically connected to the rotor (6) and eccentric with respect to the main axis (18).

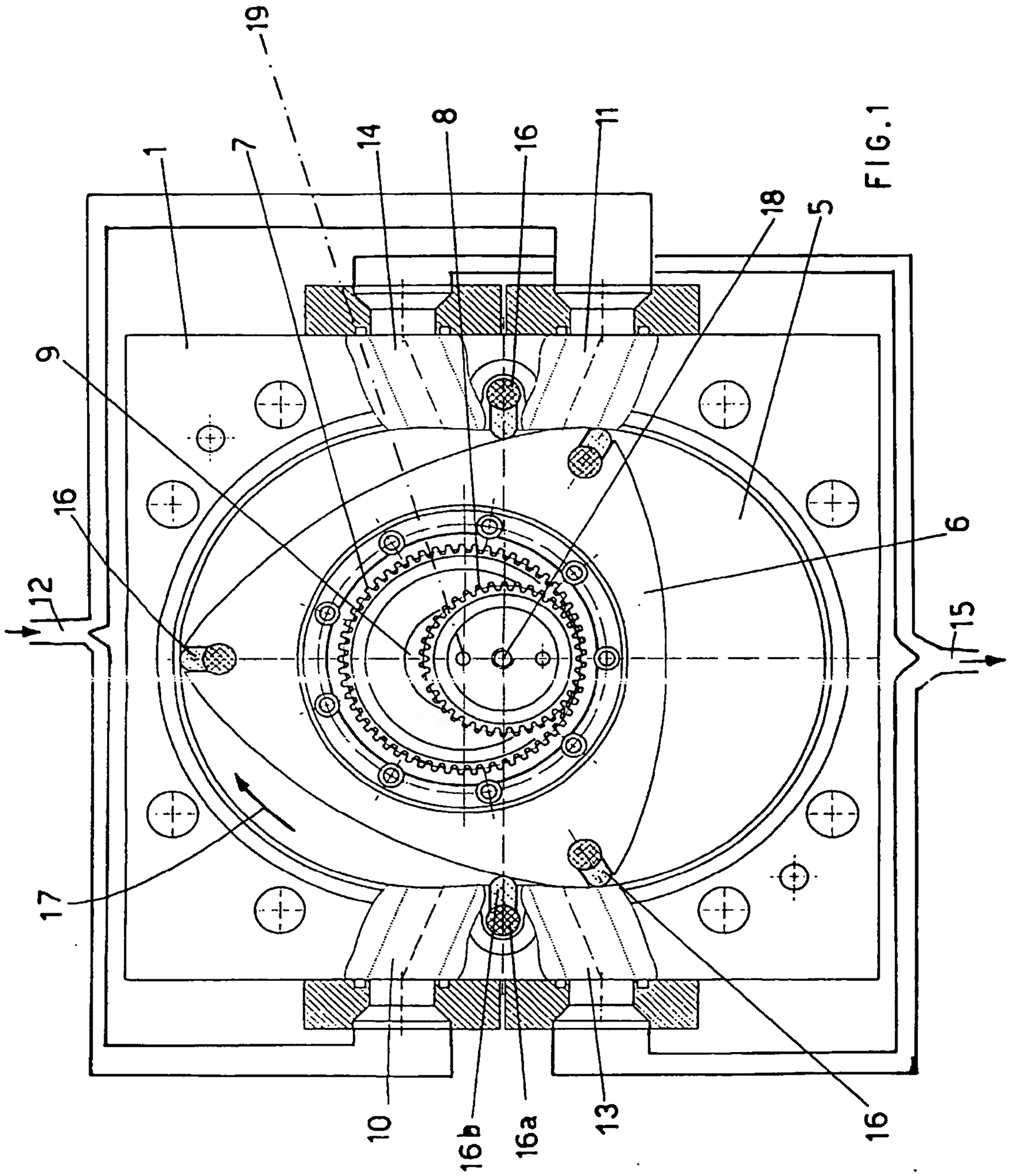

FIG.1

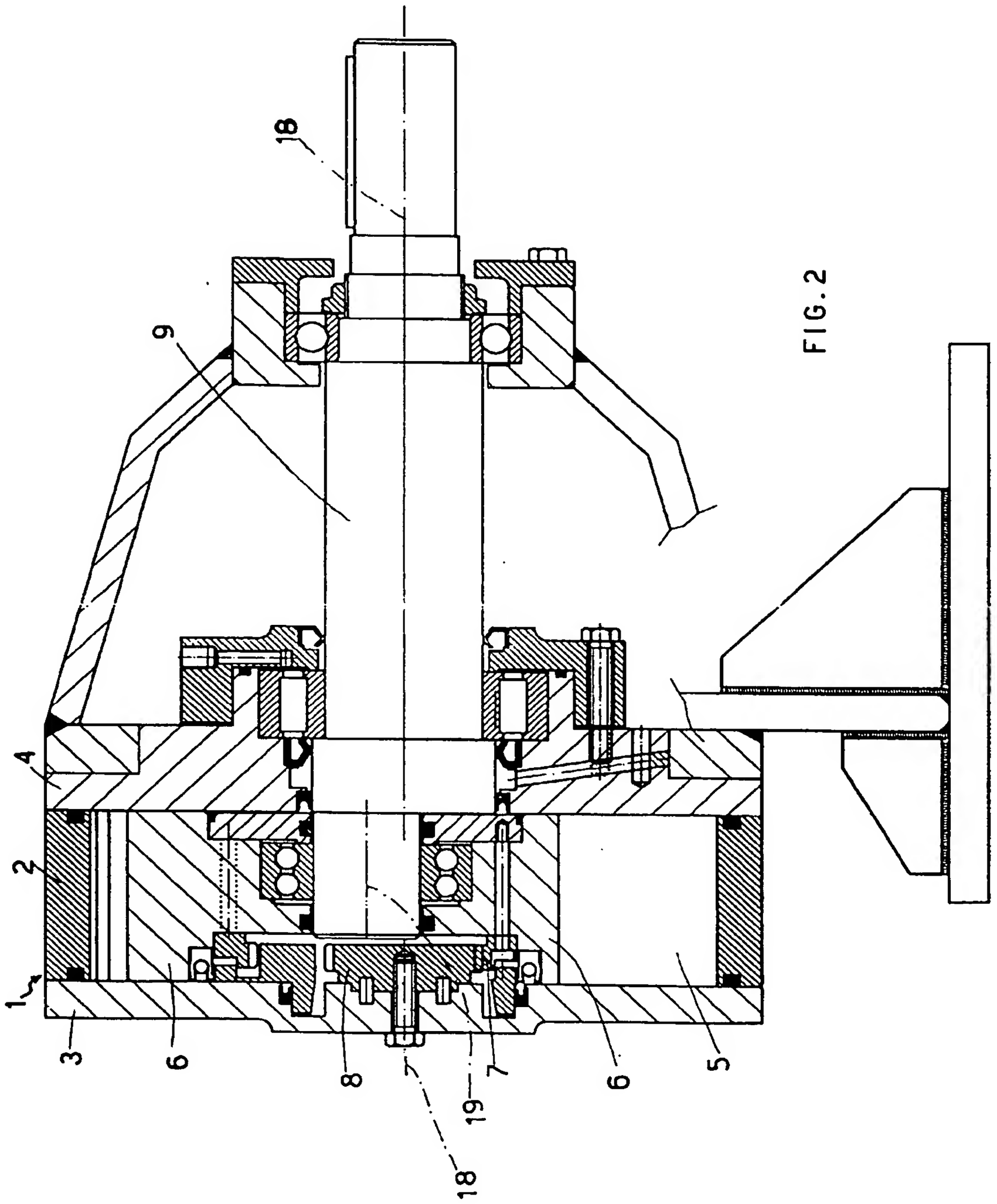

FIG.2